An hierarchical method for identifying current and emerging pest threats under climate change uncertainty

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ABSTRACT

Pest threats to agriculture depend primarily on the climate suitability of the pest risk area and the susceptibility of the hosts being grown there. There are a number of efficient and robust techniques available to identify pest threats under historical climatic conditions. It is possible to identify lists of risky pest species, estimate the suitability of the climate in the pest risk area, including the pest phenology, and even estimate the economic risk the species might pose, given climate suitability and knowledge of the hosts' distribution within the pest risk area. The more detailed the information on the risks that is sought, the more expensive and time-consuming the techniques. Hence, a structured, hierarchical approach is generally to be preferred. Considering climate change effects on pest risks is only now gaining traction, some 15 years after the techniques were first pioneered. Some pest risk techniques are inherently more suited to exploring pest risks under climate change than others. Climatic changes due to the greenhouse effect are difficult to predict because the key forcing functions driving changes in the climate are greenhouse gas emissions, and these are driven by socio-economic and geopolitical factors that are inherently uncertain at timescales that are relevant for assessing pest risks. While our ability to forecast weather systems and to hindcast climate patterns continues to improve, our ability to forecast climate changes remains stubbornly constrained by uncertainty regarding future greenhouse gas emission patterns. In turn, this constrains our ability to forecast the future climate suitability patterns for pest organisms and their hosts. While we can confidently generate future climate patterns based on emissions scenarios, we are unsure which scenario is likely to be realised. Logically, managing emerging risks under such intractable uncertainty demands a special approach based on a sensitivity analysis. In this paper we outline a hierarchical method for identifying pest risks and demonstrate some of these pest risk methods in the context of Taiwan, generating insect

pest risk lists and potential distribution maps for two case study pests. We also outline a method for managing emerging pest risks under climate change uncertainty.

Keywords: biosecurity, climate change, CLIMEX, DYMEX, invasive pest assemblages, pest risk assessment, self-organising maps